An exercise in lichenometry at Point Lonsdale

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Abstract
The growth of a white crustose lichen growing on concrete gravestones at the Point Lonsdale Cemetery was investigated. It was found that the growth rate of the lichen could be determined by using the date on the headstone, and that larger lichens tended to have a greater rate of growth. Orientation of the longest lichen axis was non-random and appears to be related to the direction of rain-bearing winds. (*The Victorian Naturalist* **124** (1), 2007, 23-26)

Introduction

Lichenometry deals with the measurement of lichen parameters, such as size, shape, rate of growth and density of thalli. These parameters may vary with age and with position of the substratum in terms of its exposure to variables such as wind, shade and atmospheric pollutants. Lichens are one of the first colonisers of rocks and are important in the management of stone monuments and buildings, as some lichens make their substratum more porous by generating oxalic and other acids and aid the weathering process (Lisci, Monte and Pacini 2001).

pH of the substratum can affect species composition, e.g. calcicolous lichens grow on neutral or alkaline substrata while silicicolous lichens grow on acidic substrata. Others can grow on any substratum. This paper deals with a white crustose lichen (Fig. 1) that commonly grows on concrete, an alkaline substratum. The aim of this study was to examine the growth of this species on concrete slabs in the Point Lonsdale Cemetery, specifically to determine whether there was a relationship between length of the longest axes of lichens and age on the headstone, whether the longest axes occurred along a particular orientation and whether growth rate varied with thallus size.

Methods

The maximum length and width of the largest lichen growing on the horizontal slabs of each of 16 graves at the Point

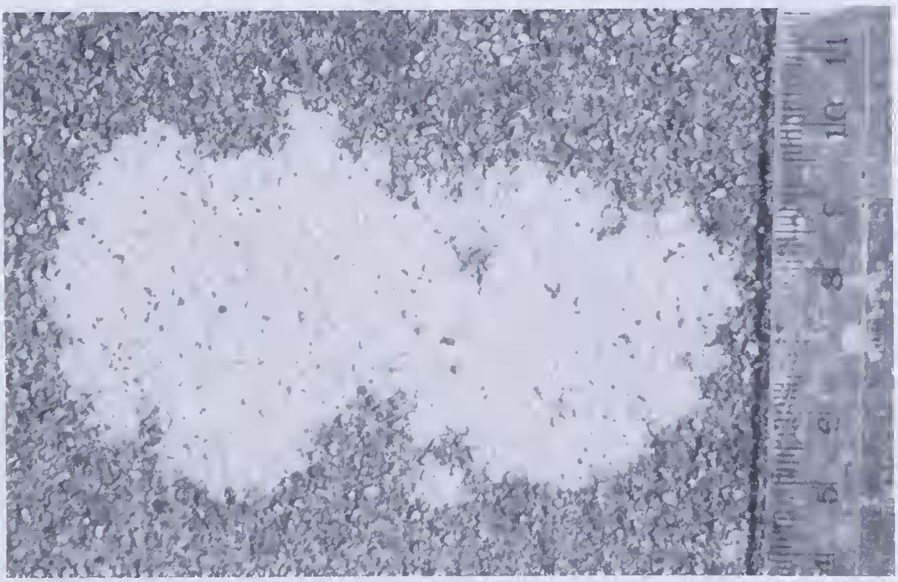

Fig. 1. White lichen occurring on graves at the Point Lonsdale Cemetery.

Lonsdale Cemetery was measured and compared with the age on the headstone. Point Lonsdale is on the western head of Port Phillip Bay, 130 km via Geelong from Melbourne.

Thalli were measured to the nearest 0.1 mm using digital vernier calipers. As well, the orientation of the longest axis was measured for the lichens with a Silva prismatic compass to determine whether this was along the direction of the prevailing weather. The concrete slabs were of uniform length and width, 2 m by 0.88 m respectively, and of similar concrete composition.

Similarly, the maximum length and width of fifty-one thalli on a single slab was measured on 1 June 2000 and re-measured on 27 July 2003, about 38 months later. The exact position of the lichens on the slab was determined to ensure that the growth rate of each lichen could be calculated. Again, the orientation of the longest axis of each lichen was measured.

Results

Ages on the 16 headstones ranged from 27.7 years to 54.9 years (Table 1). The length of the longest axes varied from 30 mm to 63 mm. There was a strong correlation (r = 0.92; *P* = 0.001) between age on the headstone and maximum lichen length. Regression analyis allowed determination of the theoretical age of the headstones (Table 1). A Chi Square goodness of fit (χ^2=4.5, df = 15, *P* = 0.995) showed there was no difference between actual age and theoretical age. This supported the strong correlation determined for lichen length and age on the headstone. Almost half the observed ages on the headstones were less than the theoretical ages predicted (Table 1), presumably due to a time lag between the burial and erection of the headstone.

Lichen growth rates were determined from the division of the maximum lichen length by the age on the headstone. Growth rates ranged from 0.9 to 1.3 mm p.a. (Table 1) but showed only a weak positive correlation with age on the headstone, which was not significant (r = 0.4, *P* = 0.1). Length and width correlated strongly with each other (r = 0.97, *P* = 0.001), but the length:width ratio (Table 1) showed only a weak correlation with age on the headstone (r = -0.45, *P* = 0.1).

Growth rates of the fifty-one lichen thalli on the single slab also were determined and ranged from 0 to 2.3 mm p.a. with an average of 0.88 mm p.a. (Table 2), marginally lower than the 1.1 mm p.a. average using the multi-slab technique. This was expected as the single slab sampling used all lichen thalli while the multi-slab sampling used only the largest thallus. Comparison of growth rate with initial maximum lichen length showed that growth rate increased with increasing

Table 1. Lichenometric data from sixteen gravestones.

age on headstone (years)	maximum length (mm)	width (mm)	orientation of longest axis (degrees from North)	growth rate (mm/year)	length/ width ratio	theoretical age (years)
27.7	31.0	25.0	105	1.1	1.2	30.7
34.1	32.7	27.9	150	1.0	1.2	32.0
34.2	30.0	23.5	135	0.9	1.3	32.0
34.2	32.7	29.9	150	1.0	1.1	29.9
40.8	50.0	48.5	47	1.2	1.0	45.1
43 0	40.5	32.0	150	0.9	1.3	37.9
45.7	61.0	58.0	68	1.3	1.1	53.4
46.3	56.4	58.6	7	1.2	1.0	49.9
47.5	52.0	47.6	30	1.1	1.1	46.6
48.4	53.5	52.0	21	1.1	1.0	47.7
50.3	60.7	52.0	45	1.2	1.2	53.2
51 0	61.0	50.0	75	1.2	1.2	53.4
52.1	57.7	53.5	135	1.1	1.1	50.9
53.7	55.4	54.5	0	1.0	1.0	49.2
54.3	63.0	57.0	20	1.2	1.1	54.9
54.9	59.5	54.7	150	1.1	1.1	52.3

lichen size (r = 0.44, P = 0.002). Thalli above an initial maximum length of 50 mm had the fastest rate of growth. The length:width ratio averaged 1.17, comparable to that obtained using the multi-slab technique, i.e. 1.10. The length/width ratio had only a weak correlation with maximum lichen length (r = 0.42, P = 0.005).

Table 2. Lichenometric data obtained using multiple gravestones.

maximum length (mm)	growth rate (mm/year)	L/W ratio	orientation (degrees from North)
11.0	0.3	1.2	110
11.0	0.1	1.1	24
13.0	1.0	1.4	158
14.0	0.2	1.5	74
16.0	1.4	1.3	116
17.5	1.1	1.2	18
19.0	1.0	1.2	30
20.0	1.0	1.3	148
20.0	0.8	1.1	86
20.0	1.8	1.2	42
20.0	0.2	1.3	142
21.0	0.2	1.1	150
21.0	0.9	1.3	163
22.0	0.1	1.1	150
22.0	0.3	1.3	110
23.0	1.6	1.2	125
24.0	0.6	1.1	172
26.0	0.2	1.1	40
28.0	0.3	1.1	116
28.0	0.7	1.1	82
28.0	0.7	1.1	82
29.0	0.2	1.4	80
29.0	0.8	1.3	110
30.0	0.1	1.1	172
30.0	0.1	1.1	120
31.0	1.1	1.4	0
31.0	2.1	1.3	72
31.0	0.3	1.1	117
31.0	0.0	1.1	52
33.0	0.2	1.1	10
35.0	1.4	1.1	90
36.0	0.4	1.2	40
36.0	0.0	1.1	105
37.0	1.3	1.1	155
37.0	1.0	1.1	36
38.0	1.6	1.2	50
38.0	1.6	1.1	60
39.0	0.5	1.0	70
39.0	0.9	1.3	143
40.0	1.6	1.2	145
40.0	1.7	1.0	154
42.0	1.3	1.3	105
44.0	0.4	1.1	140
45.0	0.1	1.1	140
45.0	1.6	1.0	128
46.0	0.9	1.1	155
48.0	2.2	1.2	130
50.0	0.8	1.1	122
51.0	2.0	1.1	146
52.0	2.5	1.1	140
52.0	2.3	1.0	170

Lichen thalli from both slabs were used to determine whether the long axes occurred along a particular orientation. Data was divided into twelve orientation classes of 15° spans. The primary mode was along the 150° axis while two secondary modes occurred along the 135° and 75° axes (Fig. 2). The distribution was significant (χ^2 = 22.8, df = 11, P = 0.025), i.e. a factor or factors other than chance was responsible for determining orientation of the longest axes.

Discussion

Bull and Brandon (1998) used the lichen genus *Rhizocarpon* to date earthquake generated rock fall events in the Southern alps of New Zealand. Their work was based on the single largest lichen or the mean of five of the largest lichens for each deposit. They listed a variety of recommendations concerning site selection and factors affecting lichen growth.

Innes (1984, 1986a) and Spence and Mahaney (1988) argue that the ideal sampling strategy in lichenometry should try to minimize inherent measurement variability by considering sample area and the density of lichen thalli. The ideal data set would come from the largest measured isolated lichen in a number of fixed-size sample areas with identical growth and conditions for colonization.

In this study the slabs on the graves were of uniform length and width and of similar composition. Density of lichens varied somewhat, but several graves had 50 or more thalli. The sampling strategy, thus, essentially met the conditions of Innes, Spence and Mahoney and that of Bull and Brandon.

Growth rate increased as lichen size increased. Bull and Brandon (1998) found similar results for *Rhizocarpon* in New Zealand, using a much greater sample size. Thus age is a factor in determining lichen size, hence the strong correlation between age on the headstone and maximum lichen length. When all sizes of lichen are considered from the one slab, the correlation between growth rate and age on the headstone is likely to be weak, and perhaps not significant.

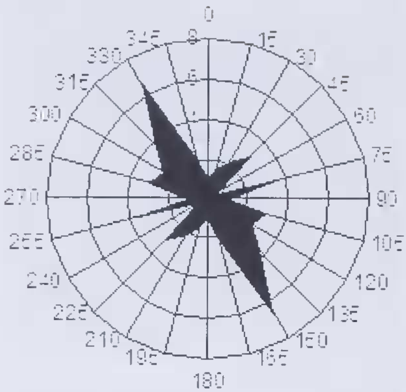

Fig. 2. Pattern showing orientation of long axes of lichens on gravestones at Point Lonsdale Cemetery. Rings represent the number of lichens. Numbers shown around the outside of the diagram show orientation in terms of degrees from North (0°).

Trunk lean, wind ramps in the tree canopy, elongated tree bole profiles, direction of fallen limbs and canopy profiles have been used to determine the dominant prevailing wind in an area Schleiger (1982, 1983, 1991, 2004). For Victoria the most frequent prevailing wind throughout the year is NW and NNW with westerlies and southwesterlies especially in the winter. The cool change or cold front is preceded by the northerlies (NNW and NW) with a wind swing through westerlies and southwesterlies when the cool change passes through from W to E across the state. Rain usually falls with the northerly component, followed by showers from the W and SW in the clearing phase. The pattern of the rosette in Figure 2 reflects that of the tree rosettes at Bundoora, Coburg and Carlisle Forest in the Otways. The similarity of directional pattern with the lichen growth on the slabs suggests the idea of directional rain as an influence in the direction of growth of the lichen thallus investigated in this study.

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